Measurement of cross section lineshape of $e^+e^- \to \phi\eta$ in energy region 2.0 - 3.08 GeV

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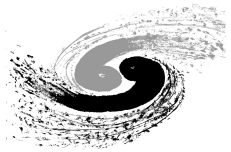
Preliminary Result Application





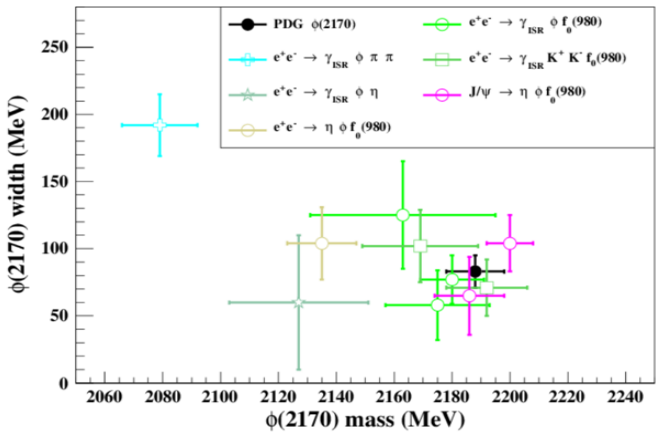

$\phi(2170)$ Physics Motivation

- Published measurements:
  - Limited decay modes;
  - Inconsistence on mass and width.
- Theory explanations of $\phi(2170)$:
  - $s\bar{s}g$ hybrid Phys. Lett. B **650**, 390 (2007);
  - 2^3D_1 or 3^3S_1 $s\bar{s}$ quarkonium Phys. Lett. B **657**, 49 (2007);
  - Tetraquark $s\bar{s}s\bar{s}$ Nucl. Phys. A **791**, 106 (2007);
  - Molecular state $\Lambda\bar{\Lambda}$ Phys. Rep. **454**, 1 (2007), Phys. Lett. B **639**, 263 (2006);
  - $\phi f_0(980)$ resonance with FSI Phys. Rev. D. **91**, 052017;
  - Three body system ϕK^+K^- $\phi f_0(980)$ resonance with FSR Phys. Rev. D. **78**, 074031.

$\phi(2170)$ DECAY MODES

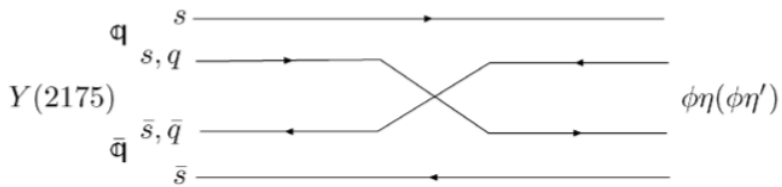
	Mode	Fraction (Γ_i/Γ)
Γ_1	e^+e^-	seen
Γ_2	$\phi\eta$	
Γ_3	$\phi\pi\pi$	
Γ_4	$\phi f_0(980)$	seen
Γ_5	$K^+K^-\pi^+\pi^-$	
Γ_6	$K^+K^-f_0(980) \to K^+K^-\pi^+\pi^-$	seen
Γ_7	$K^+K^-\pi^0\pi^0$	
Γ_8	$K^+K^-f_0(980) \to K^+K^-\pi^0\pi^0$	seen
Γ_9	$K^{*0}K^{\pm}\pi^{\mp}$	not seen
Γ_{10}	$K^*(892)^0\overline{K}^*(892)^0$	not seen

C. Patrignani *et al.* (Particle Data Group), (Chin. Phys. C, 40, 100001 (2016).

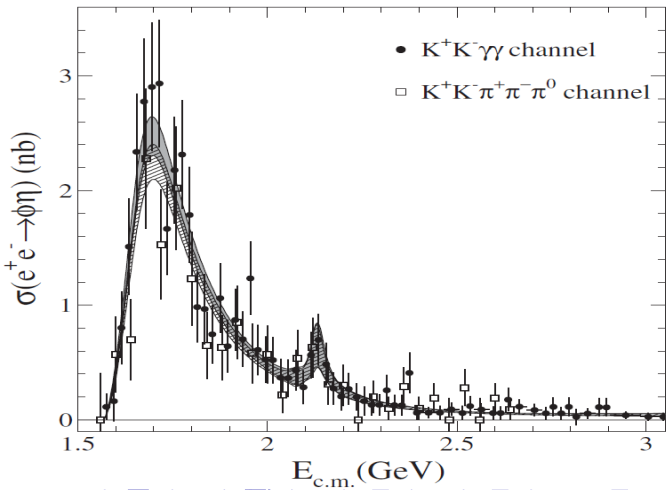


$e^+e^- \to \phi\eta$ and $\phi\eta'$ Motivation

- Aspects of $\phi(2170)$ are still not fully understood.
- **Large J/ψ events and energy scan data at BESIII provide the opportunity to perform the further study to $\phi(2170)$.**
- Tetraquark favorites $\phi\eta$ and $\phi\eta'$ Phys. Lett. B **669**, (2008) 160-166.
- $\phi\eta$ mode: isoscalar
  - Only ϕ^* and ω^* (OZI suppressed);
  - Useful to measure parameter.



- BaBar have measured the $e^+e^- \to \phi\eta$ cross section in ISR method Phys. Rev. D **77**, 092002 (2008). We should improve the uncertainty by energy scan method.



Measurement of $e^+e^- \to \phi\eta$ cross section

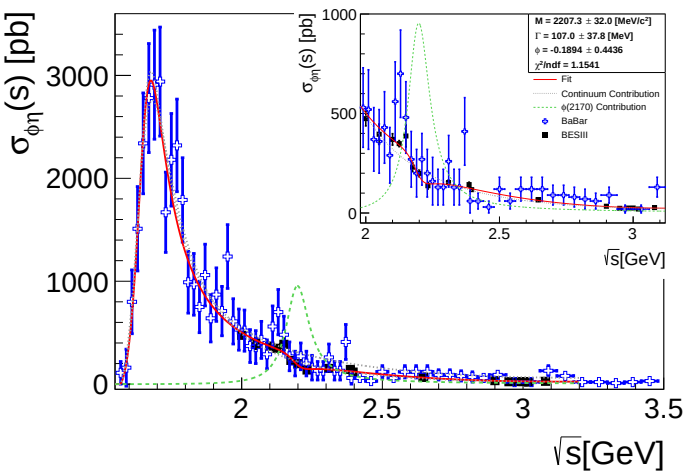
- We fit σ_{born} in the formula Phys. Rev. D **77**, 092002 (2008):

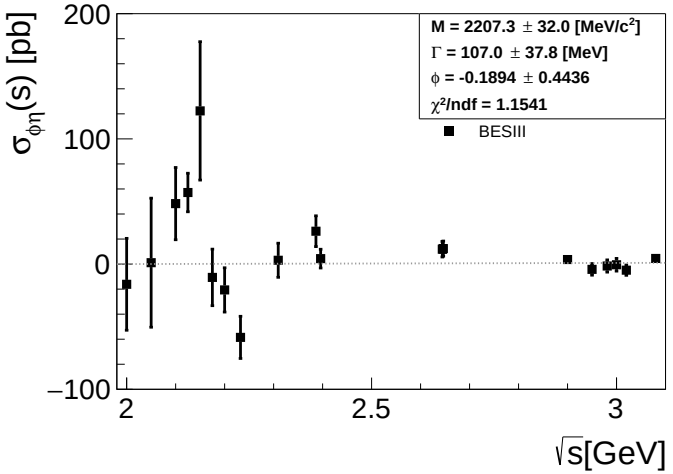
$$\sigma_{\phi\eta}(s) = 12\pi\mathcal{P}_{\phi\eta}(s)|A^{n.r.}_{\phi\eta}(s)+\sum_R \sqrt{\mathcal{B}^R_{\phi\eta}\Gamma^R_{ee}}\frac{\sqrt{\Gamma_R/\mathcal{P}_{\phi\eta}(M^2_R)}e^{i\Psi_R}}{M^2_R - s - i\sqrt{s}\Gamma_R(s)}|^2$$

  - $A^{n.r.}_{\phi\eta}(s)$ describes the nonresonant background, mainly due to the tails of resonances below threshold, and the sum runs over all the vector resonances, with mass M_R, width Γ_R, and relative phase Ψ_R, assumed to contribute to the cross section.
  - All of the final states analyzed contain a vector and a pseudoscalar meson.
  - $\mathcal{P}_{\phi\eta}(s)$: the phase space of the $\phi\eta$.

$$\mathcal{P}_{\phi\eta}(s) = [\frac{(s + M^2_\phi - M_\eta)^2 - 4M^2_\phi s}{s}]^{3/2}$$

Significance of Y(2175)





- M=2207.3±32.0 MeV;
- Γ=107.0±37.8 MeV;
- ϕ=-0.1894±0.4436;
- The Significance of $\phi(2170)$ is 9.119.